Signals, systems and circuits

Academic Year: (2022 / 2023) **Review date: 20-05-2022**

Department assigned to the subject: Electronic Technology Department

Coordinating teacher: FERNANDEZ HERRERO, CRISTINA

Type: Compulsory ECTS Credits : 6.0

Year : 2 Semester : 2

OBJECTIVES

- Characterize and analyze signals and systems, continuous and discrete, in the time domain and in the frequency domain.
- Understand and master the concept of frequency response
- Understand the process of digitizing analog signals.
- Develop the ability to analyze and design systems.
- Learn the analysis of circuits in the time domain, in permanent sinusoidal regime and in the frequency domain.
- Learn the transitory analysis of first and second order circuits.

DESCRIPTION OF CONTENTS: PROGRAMME

A. Signals

1.Taxonomy of signals

1.1. Introduction: functions and signals. Continuous and Discrete time domain. Sampling. Basic Taxonomy of signals

1.2. Properties of signals: periodicity, symmetry, energy signal, power signal

1.3. Basic operations with signals: level shift, time shift, reflection, scaling.

1.4. Signals characterization: mean and root mean square value, energy, average power

1.5. Basic Signals: sine wave, complex exponential, impulse, unit step

2. Representation of signals

2.1 From time domain to frequency domain: Signal transforms, Fourier revision

2.2 The decibel

2.3 Fourier transform of basic signals

2.4. properties of Fourier Transform. Convolution property and Parseval Theorem

2.5 Power spectrum of a signal

2.6 Basic estimation of power spectrum

2.7 Signals in Matlab

B. Systems

3.-Signal processing: LTI systems

3.1. System definition and block diagram. Classification

3.2. Systems interconnection: series, parallel, feedback

3.3. System properties: memory, invertibility, causality, stability, time invariance, linearity

3.4. Linear and Time invariant systems (LTI). Impulse response and transfer fucntion. Palace and Z transform as an extension of Fourier

3.5 Convolution

4. Representation of LTI systems

4.1 Pole-Zero plot

4.2 BIBO estability

4.3 First order system: impulse response, step response. Frequency response

4.4 Real and asymptotic Bode Plot

4.5 Second order systems: impulse response, step response. Frequency response. Overdamped systems, underdamped systems, and critically damped systems.

4.6 LTI systems in Matlab

5. Sampling and reconstruction
5.1 Discrete-Time Processing of Analog signals
5.2 Ideal and Periodic sampling
5.3. Sampling Theorem
5.4 Prefiltering
5.5 Ideal reconstruction
5.6 Reconstruction with a zero-order hold

C. Circuits
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6. Introduction to circuit theory
6.1. Definition of circuits: fundamental variables, basic elements, connections
6.2. Energy and power
6.3. Kirchhoff¿s laws. KVL and KCL
6.4. Electric components. Resistor, inductor, capacitor. Independent and dependent voltage and current sources
6.5. Series and parallel connection
6.6. Superposition
6.7. Thevenin equivalent
6.8. Norton equivalent

7. Transient analysis
7.1. Transients in first order circuits
7.2. Introduction to simulation using LTspice
7.3. Transients in second order systems: overdamped systems, underdamped systems and critically damped systems

8. Sinusoidal steady-state analysis
8.1. Impedance model
8.2. Frequency response of RC and RL circuits
8.3. Frequency response: magnitude and phase

LEARNING ACTIVITIES AND METHODOLOGY

THEORY CLASS. Classroom presentations by the teacher in which the subject`s main concepts are developed, while providing material and bibliography to complement student learning
PRACTICAL CLASS. Resolution of practical cases and problem, posed by the teacher, and carried out individually or in a group
TUTORING SESSIONS. Individualized attendance (individual tutoring sessions) or in-group (group tutoring sessions) for students with teacher as tutor.
LABORATORY PRACTICAL SESSIONS. Applied/experimental learning/teaching in workshops and laboratories under the tutor's supervision.

ASSESSMENT SYSTEM

- Laboratory (20%).
- Exams during the course (20%).
- Final exam oriented to problems (60% with a minimum grade).

% end-of-term-examination:	60
% of continuous assessment (assigments, laboratory, practicals…):	40

BASIC BIBLIOGRAPHY

- Alan Oppenheim, Alan Willsky Signals and systems, Prentice-hall, 1996

- Anant Agarwal, Jeffrey H. Lang Foundations of Analog and Digital Electronic Circuits, Morgan Kaufmann Publishers, Elsevier, 2005

ADDITIONAL BIBLIOGRAPHY

- Dutta Roy, Suhash Chandra Circuits, Systems and Signal Processing: A Tutorials Approach Dutta Roy, Suhash Chandra, Singapore: Springer Singapore Pte. Limited, 2018